TRUNNION ASSEMBLY

INTRODUCTION AND BACKGROUND TO THE INVENTION

This invention relates to a trunnion assembly.

A conventional gun, such as a cannon or the like, includes two trunnion assemblies for supporting the barrel of the gun. The trunnion assemblies are disposed on opposite sides of the barrel and each assembly includes a trunnion shaft rotatably received in a bore of a trunnion housing mounted on a support. The trunnion shaft is pivotally movable in the bore about its longitudinal axis to accommodate elevation of the barrel of the gun, however, its longitudinal axis is retained against movement out of concentric alignment with the longitudinal axis of the bore.

A disadvantage of the conventional trunnion assemblies is that when the gun is fired, the impetus caused by the rearward movement of the gun is transferred via the trunnion shafts and the trunnion housings to the static components of the support. Excessive metal fatigue is thus caused, often resulting in the trunnion shafts being ripped out of the housings.

OBJECT OF THE INVENTION

It is therefore an object of the present invention to provide a trunnion assembly with which the aforesaid disadvantage can be overcome or at least minimised.

SUMMARY OF THE INVENTION

According to a first aspect of the invention there is provided a trunnion assembly comprising:

- a trunnion shaft; and
- a housing defining a bore for rotatably and concentrically receiving the trunnion shaft,

the trunnion assembly according to the present invention being characterised in that the longitudinal axis of the shaft is movable out of alignment with the longitudinal axis of the bore when the shaft is biased in a direction transverse the said longitudinal axes.

Further according to the invention the trunnion assembly includes a bearing assembly located inside the housing and surrounding the trunnion shaft and which allows rotation of the shaft in the bore whilst also allowing the said movement of the longitudinal axis of the shaft out of alignment with the longitudinal axis of the bore.

The bearing assembly may include a toroidal-type roller bearing assembly.

The bearing assembly may further include a re-aligning means for re-aligning the longitudinal axes of the shaft and the bore, after the said movement out of alignment.

The re-alignment means may be in the form of a ball bearing assembly also located inside the bore of the housing and surrounding the trunnion shaft.

The ball-bearing assembly may include a central ball bearing and two resiliently compressible O-rings disposed on opposite sides of the ball bearing.

The O-rings may each be located in an O-ring retainer.

A cam ring may be disposed between each O-ring and the ball bearing, each cam ring having a cam surface for abutting an outer surface of the ball-bearing, the arrangement being such that when the trunnion shaft moves out of concentric alignment with the bore, one of the cam rings moves towards its O-ring to compress the same, the arrangement being further such that the compressed O-ring expands after the biasing force has been neutralised to move the shaft back into concentric alignment with the bore.

According to a second aspect of the invention there is provided a gun provided with a trunnion assembly according to the first aspect of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described further by way of a non-limiting example with reference to the accompanying drawings wherein:

figure 1 is a perspective view of a trunnion assembly according to a preferred embodiment of the invention;

figure 2 is an exploded view of the trunnion assembly of figure 1;

figure 3A is a longitudinal-sectional view along lines A-A in figure 1, with a longitudinal axis B of a shaft and a longitudinal axis C of a bore aligned;

figure 3B is a longitudinal-sectional view along lines A-A in figure 1 with the longitudinal axis B of the shaft and the longitudinal axis C of the bore misaligned;

figure 4 is a detailed view of a bearing assembly of the trunnion assembly of figure 1;

figure 5A is a front view of an internal O-ring retainer of a re-alignment means of the bearing assembly of figure 4;

figure 5B is a cross-sectional view along lines V-V in figure 5A;

figure 5C is a detailed view of the section as indicated in figure 5B;

figure 6A is a front view of an external O-ring retainer of the re-alignment means referred to in figure 5A;

figure 6B is a cross-sectional view along lines VI-VI in figure 6A;

figure 6C is a detailed view of the section as indicated in figure 6B;

figure 7A is a front view of a cam ring of the re-alignment means referred to in figure 5A;

figure 7B is a cross-sectional view along lines VII-VII in figure 7A; and

figure 7C is a detailed view of the section as indicated in figure 7B.

DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

Referring to figures 1 to 3, a trunnion assembly according to a preferred embodiment of the invention is generally designated by reference numeral 10.

The trunnion assembly 10 comprises a trunnion shaft 12; and a housing 14 defining a bore 16 for rotatably and concentrically receiving the trunnion shaft 12. Referring to figures 3 and 4, the trunnion assembly 10 further includes a bearing assembly 18 located inside the housing 14 and surrounding the trunnion shaft 12. The bearing assembly 18 allows rotation of the shaft 12 in the bore 16 whilst also allowing movement of the shaft 12 so that the longitudinal axis B of the shaft 12 is movable out of alignment with the longitudinal axis C of the bore 16 when the shaft 12 is biased in a direction transverse the said longitudinal axes B and C.

The bearing assembly 18 includes a toroidal-type roller bearing assembly 20, which allows for concentric misalignment of the shaft 12 inside the bore 16. The bearing assembly 18 further includes a re-aligning means that re-aligns the

longitudinal axis B of the shaft 12 with the longitudinal axis C of the bore 16, after the said misalignment, as indicated in figure 3B.

Referring further to figures 5 to 7, the re-alignment means includes a ball bearing assembly also located inside the housing 14 and surrounding the trunnion shaft 12. The ball-bearing assembly includes a central ball bearing 22 and two resiliently compressible O-rings 24. The O-rings 24 are each located in an O-ring retainer 26A and 26B, and disposed on opposite sides of the ball bearing 22. One O-ring retainer 26A is shown in more detail in figures 5A to 5C and the other O-ring retainer 26B is shown in more detail in figures 6A to 6C.

Referring particularly to figures 7A to 7C, a cam ring 28 is disposed between each O-ring 24 and the ball bearing 22. Each cam ring 28 has a cam surface 30 that abuts an outer surface of the ball-bearing 22. The cam surface 30 is rounded and aids in the re-alignment of the shaft 12.

Referring particularly to figure 3B, in use, when a gun (not shown) is fired, the longitudinal axis B of the trunnion shaft 12 moves out of alignment with the longitudinal axis C of the bore 16. Simultaneously, one of the cam rings 28 moves towards its O-ring 24 to compress the same in its retainer 26. Concomitantly the rollers of the toroidal-type roller bearing 20 are able to move at a misaligned angle in the raceways of the bearing 20, while being confined to the raceways. After compression, the O-ring 24 expands after the biasing force

has been neutralised to move the longitudinal axis B of the shaft 12 back into alignment with the longitudinal axis C of the bore 16. This is achieved by the cam surface 30 of the cam ring 28 pressing against the outer surface of the ball-bearing 22.

The applicant has found that the trunnion assembly 10 allows for the longitudinal axis B of the shaft 12 to be movable out of alignment with the longitudinal axis C of the bore 16 when the shaft 12 is biased in a direction transverse the said longitudinal axes B and C, such as when the gun is fired. The applicant has further found that this will reduce the impetus caused by the rearward movement of gun, which is transferred to the static components of the support, and therefore alleviate excessive metal fatigue.

It will be appreciated that variations in detail are possible with a trunnion assembly according to the invention without departing from the scope of the appended claims.